IOWA DOT
SMARTER I SIMPLER I CUSTOMER DRIVEN

Office of Design

Special Intersection and Interchange Designs and Freight considerations

Brian Smith, P.E.

Discussion Topics

- Special Intersection Designs
  - Roundabouts
  - Roundabout Screening Tool
  - J-Turns
  - Painted Stop Sign Islands
  - Offset Left and Right turns
  - Auto Turn Program
    - Large Specialty Vehicles
    - 3D version

Discussion Topics continued

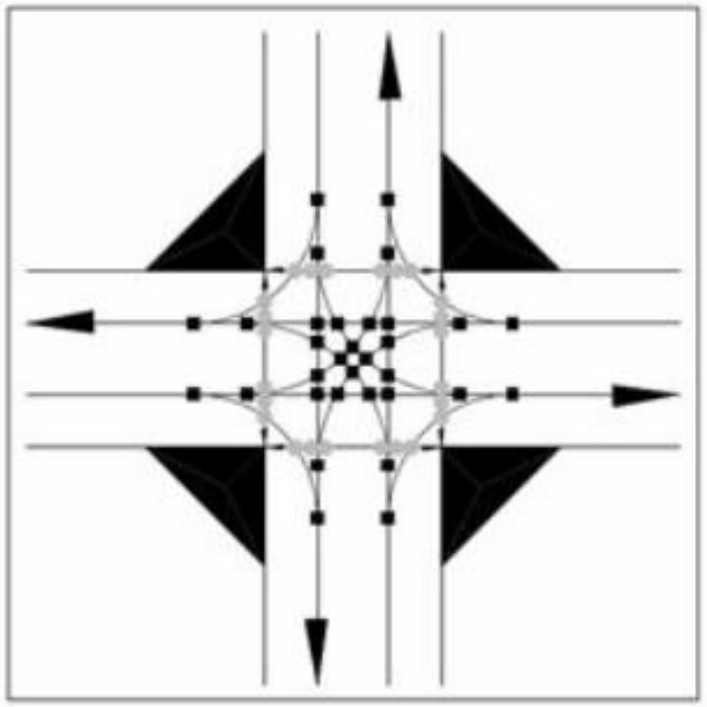
- Special Interchange Designs
  - Parallel acceleration/deceleration lanes at ramp tapers
  - Diverging Diamonds
  - Single Point Interchanges
  - Diamond Interchange with roundabout terminals
- Traffic management considerations during design

Freight Routes

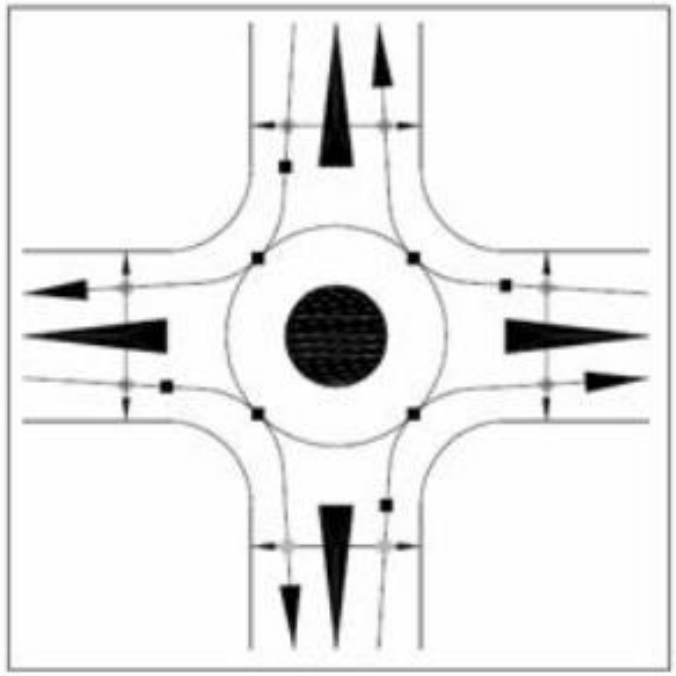
Special Intersection Designs (Roundabouts)

Special Intersection Designs (Roundabouts)

- Advantages of a roundabout



Standard two-lane conflict points



Single-lane roundabout conflict points

Special Intersection Designs (Roundabouts)

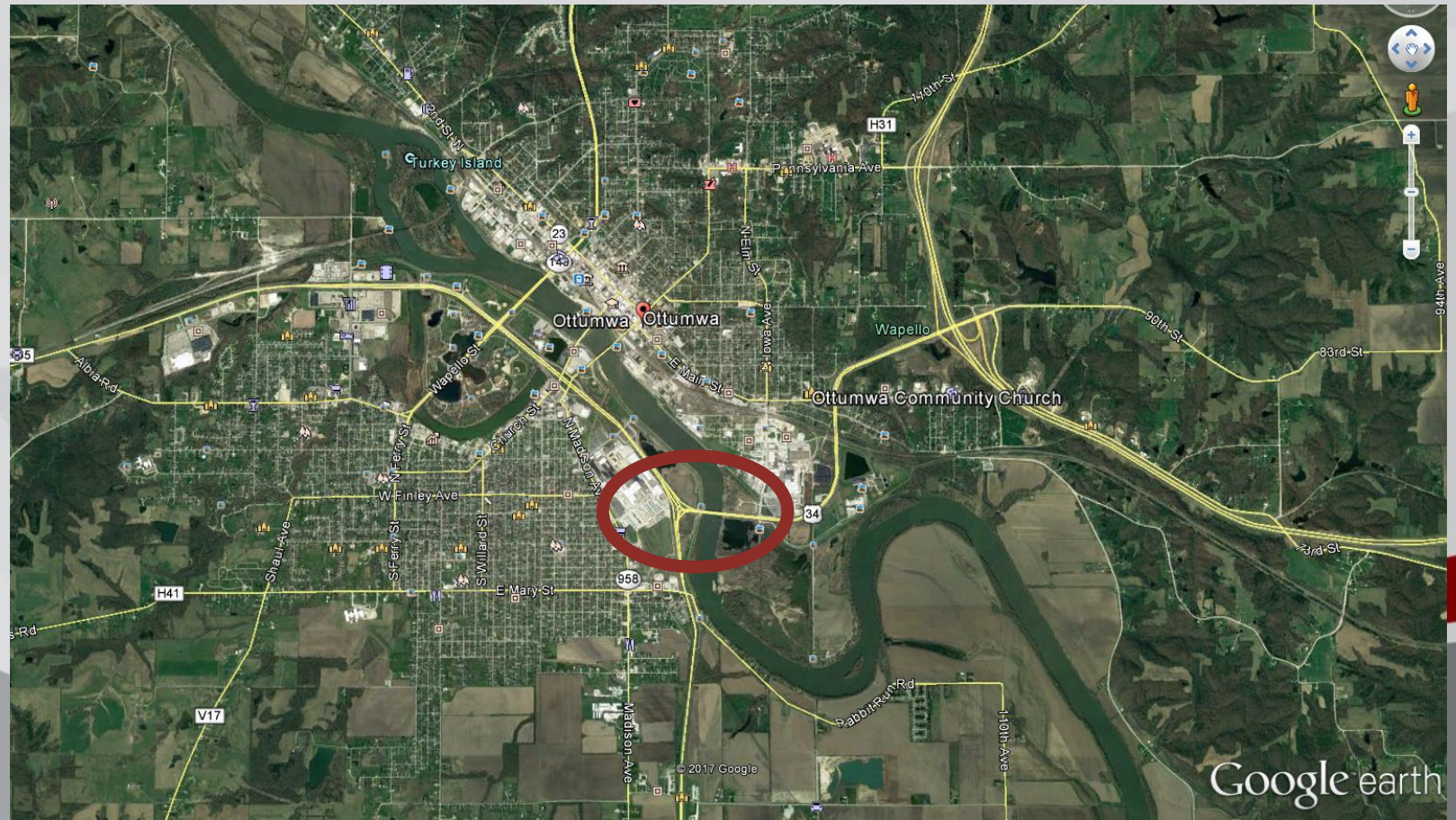
- Advantages of a roundabout
  - 90 percent reduction in fatal crashes
  - 76 percent reduction in injury crashes
  - 30-40 percent reduction in pedestrian crashes
  - 10 percent reduction in bicycle crashes
  - Lower vehicle speeds
  - Less vehicle pollution
  - Lower maintenance cost compared to a traffic signal

Special Intersection Designs (Roundabouts)

- Freight challenges with roundabouts
  - Tight geometry reduces passenger car speeds but challenging for large trucks
  - Pavement slopes are adverse for high center of gravity vehicles
  - Raised portions of the roundabouts can cause low clearance trailers to hang up
  - Oversized loads may have trouble negotiating the roundabout

Special Intersection Designs (Roundabouts)

- Case Study for Iowa
  - Ottumwa Roundabout Wapello County Intersection of US 34 and US 63
  - First roundabout built on the primary system



Special Intersection Designs (Roundabouts)

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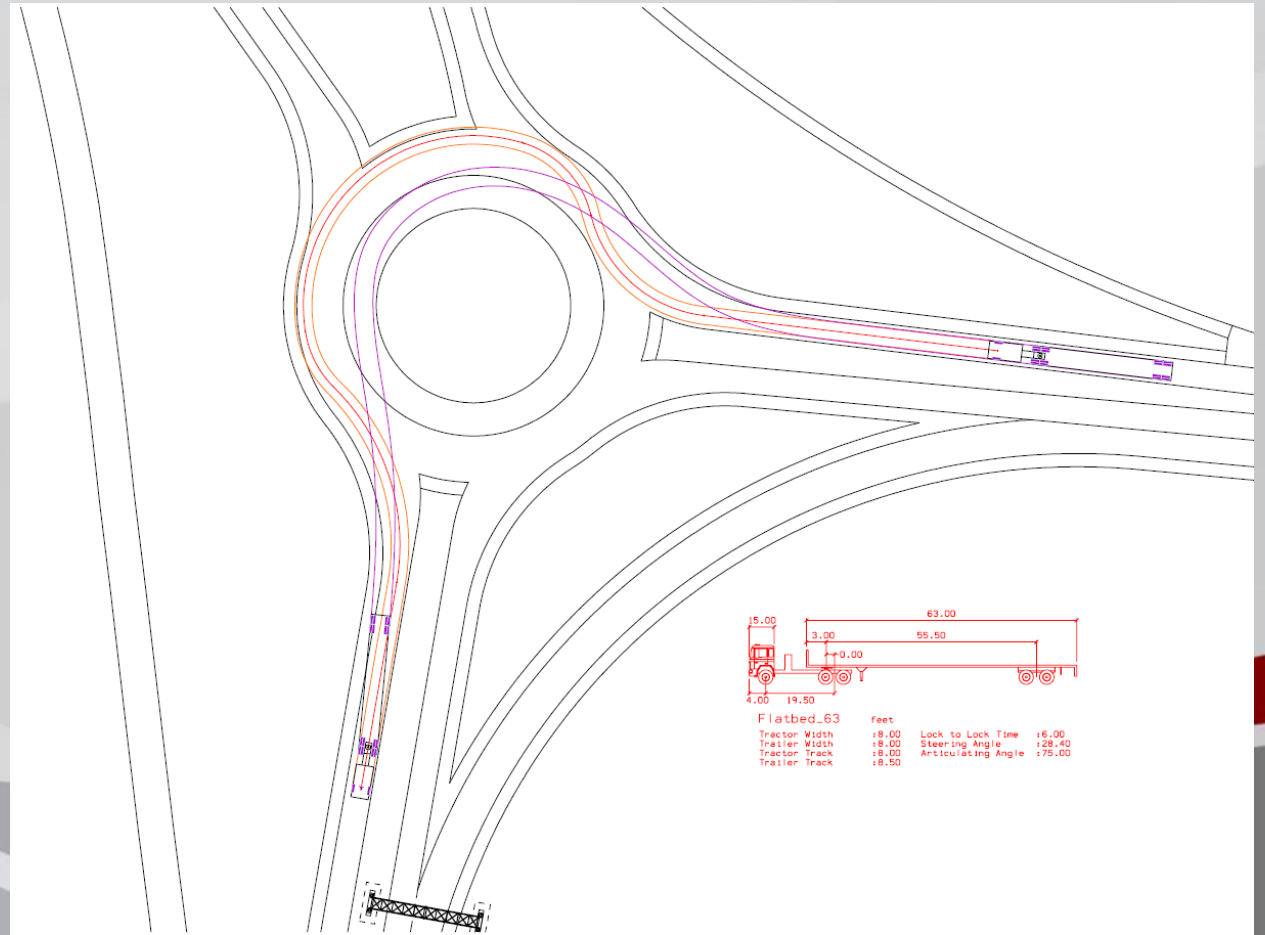
Special Intersection Designs (Roundabouts)

- Trucks were a consideration with the design
- Turning movements were reviewed

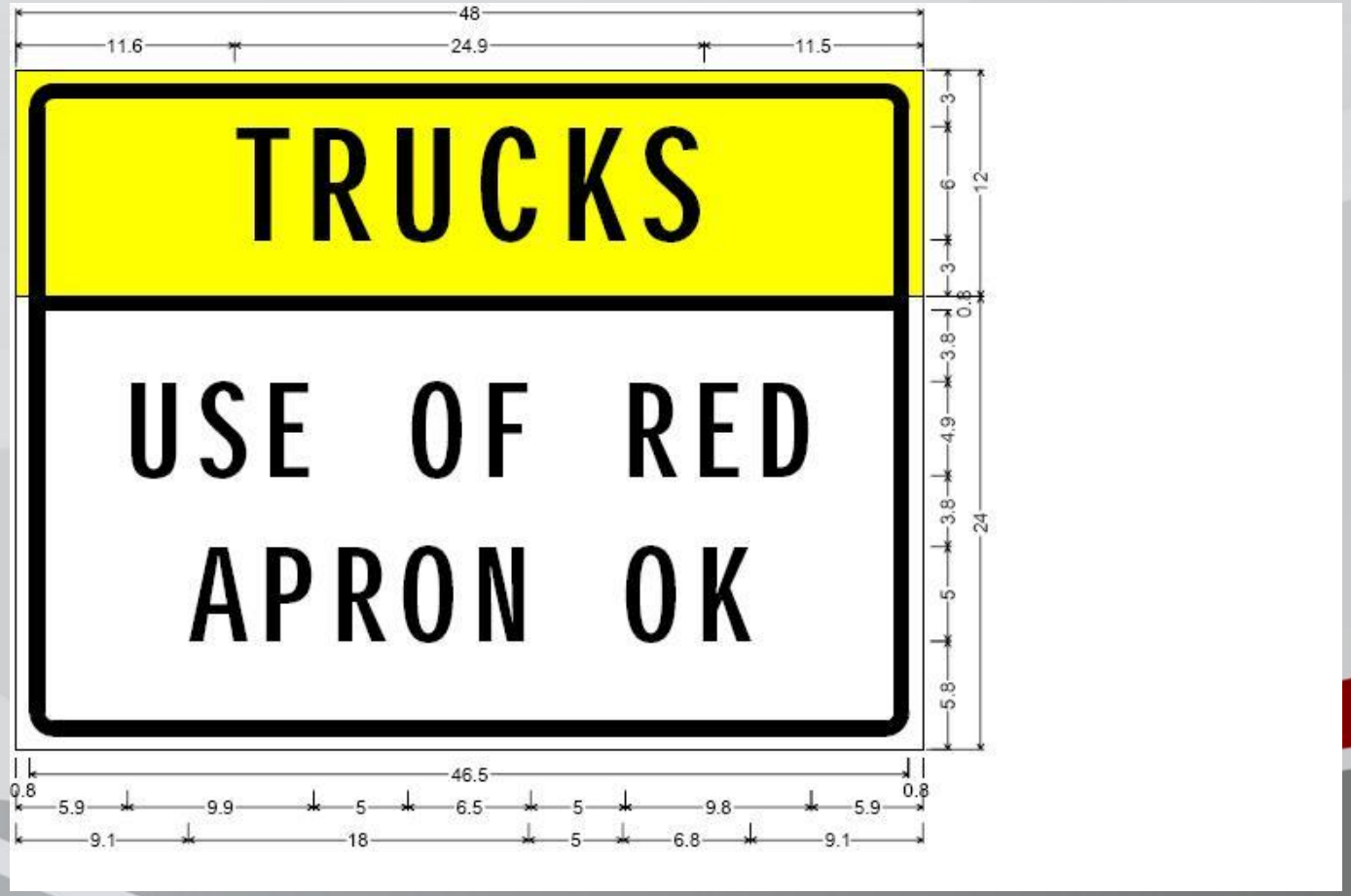


Special Intersection Designs (Roundabouts)

- Trucks aprons were added to the design

Special Intersection Designs (Roundabouts)

- Trucks aprons were not used because truck drivers were hesitant to drive on the brick pattern
- Signs were added to inform truck drivers that is was OK to drive on truck apron



Special Intersection Designs (Roundabouts)

- Rutting on the edges of the roundabout became an issue on the outside edges of the roundabout.
- A curb and paved shoulder was added to help control the passenger cars but to give trucks more working room.

Special Intersection Designs (Roundabouts)

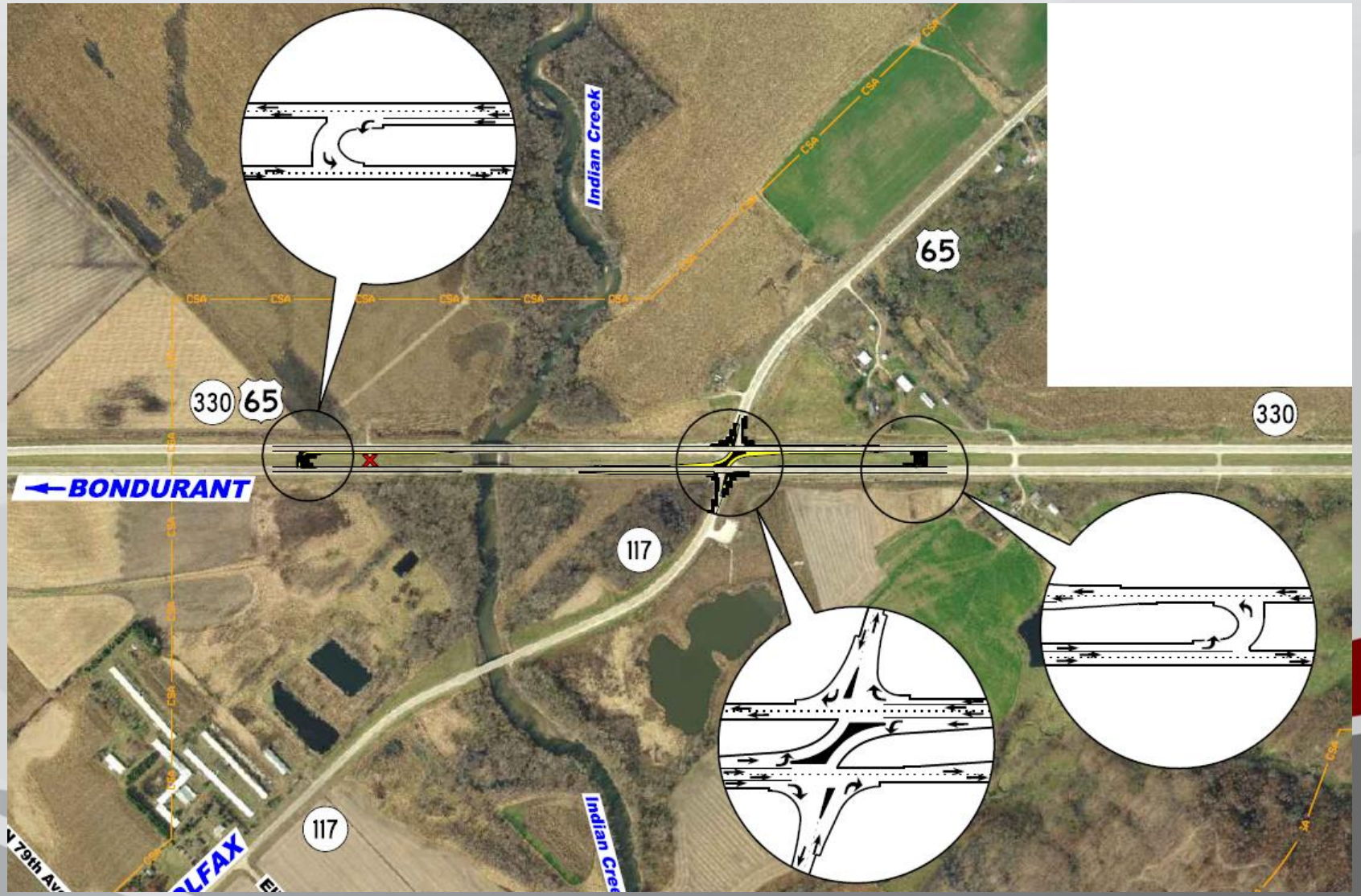
Special Intersection Designs (Roundabouts)

Roundabout Feasibility Initial Screening Tool

The intent of this screening tool is to provide a relatively quick assessment of the feasibility of a modern roundabout at a particular intersection in comparison to other appropriate forms of traffic control or road improvements. The intended outcome is to provide information to assist staff in deciding whether the safety and operational benefits of a roundabout outweigh potential limitation to freight.

1. Intersection location.
2. Project Description and the purpose and need for this project (e.g. add capacity, correct safety problem, pavement replacement, etc.).
3. Adjacent land use and access.
4. Contact the Motor Vehicle Division (MVD) to determine the number of oversized/overweight vehicles routed through this location annually and MVD's opinion of this route's importance to freight movement.
5. Attach sketches of the current configuration and of the proposed configurations showing:
    - Intersection control.
    - Number of legs.
    - Lanes on each leg.
    - Existing and projected traffic volumes for each movement including percentage of trucks (HV).
    - Estimated costs for each presented option.
6. Advantages the roundabout option will provide at this location over other options.
7. Impact on nearby properties, including internal circulation routes within the property.
8. Design vehicle to be used for the roundabout.
9. Describe whether accommodation of superloads was considered (e.g. use a parallel route, close traffic temporarily and allow vehicles to use exit lanes for left turn movements, etc.).
10. What type of non-motorized vehicles are expected (pedestrians, bicycles, horse and buggy, etc.) and whether special accommodations are required.

Special Intersection Designs (J-Turns)



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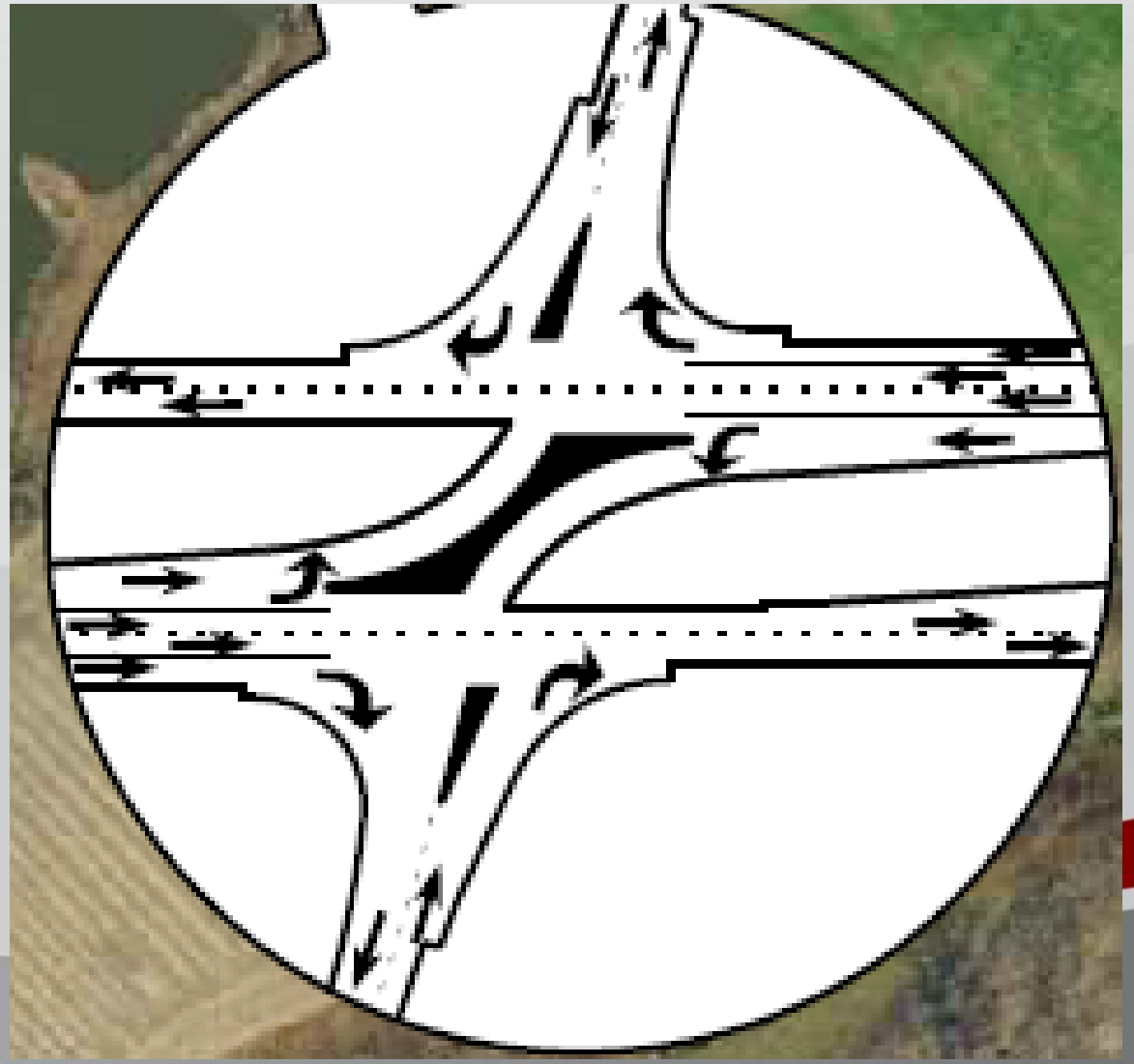

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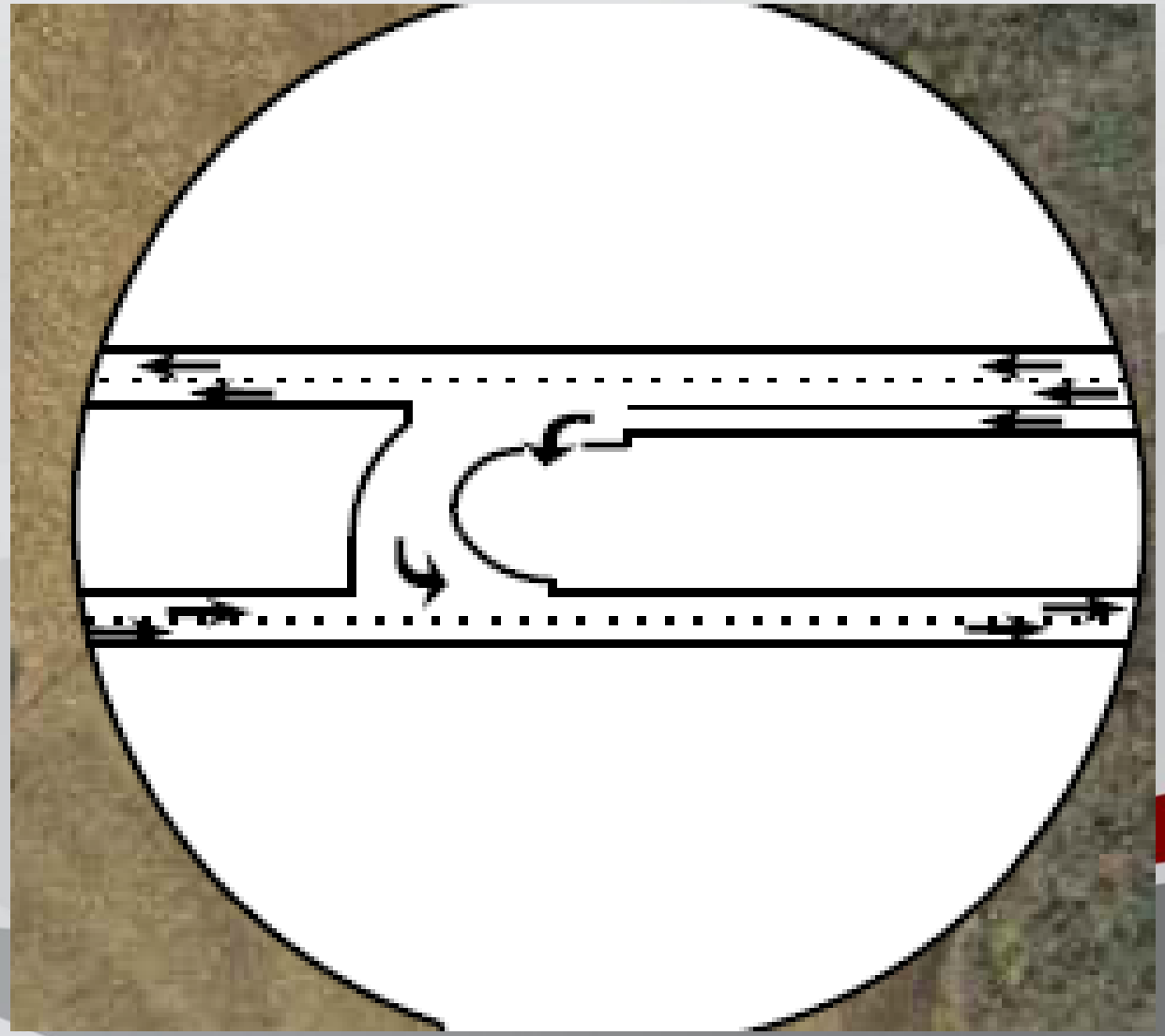

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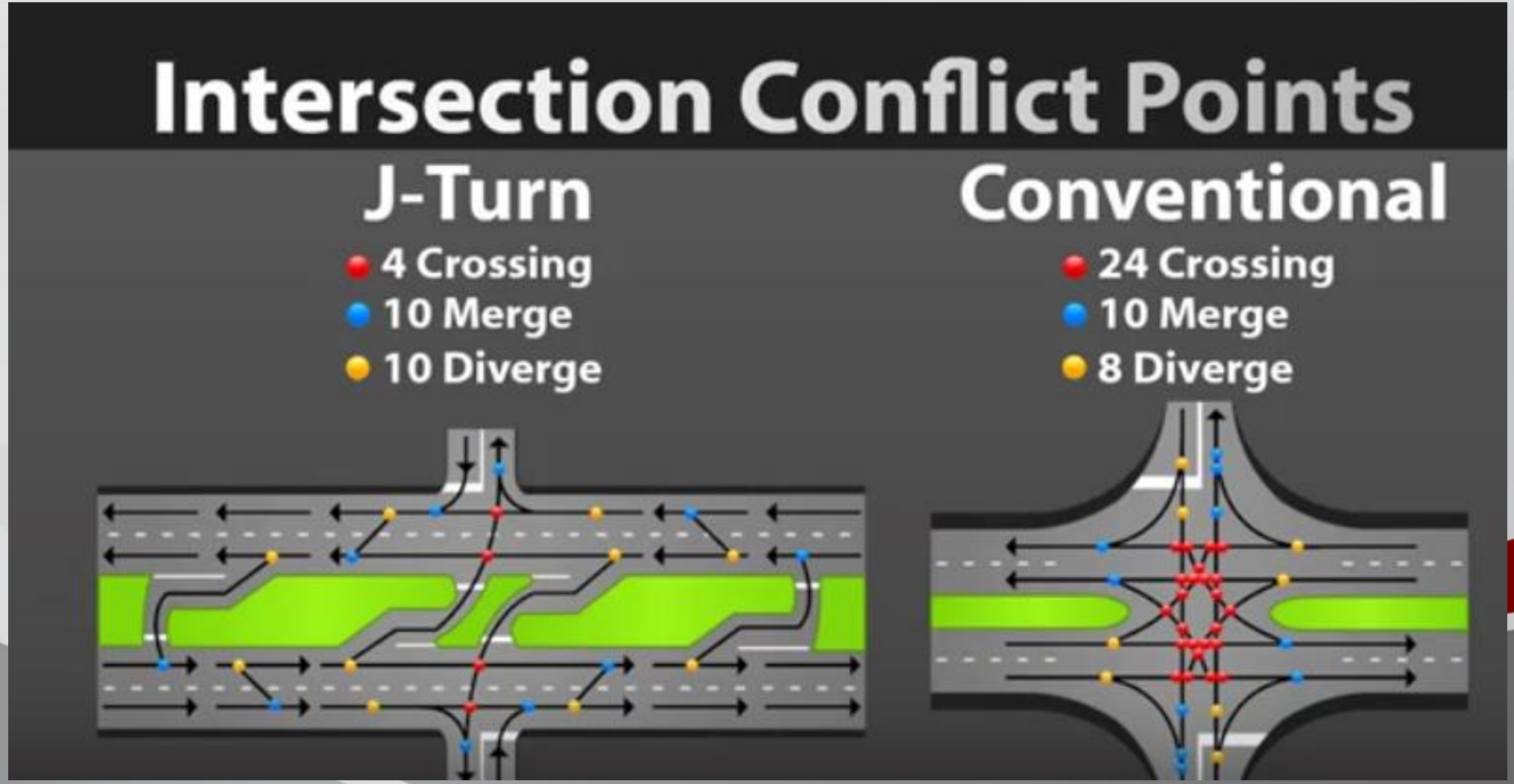

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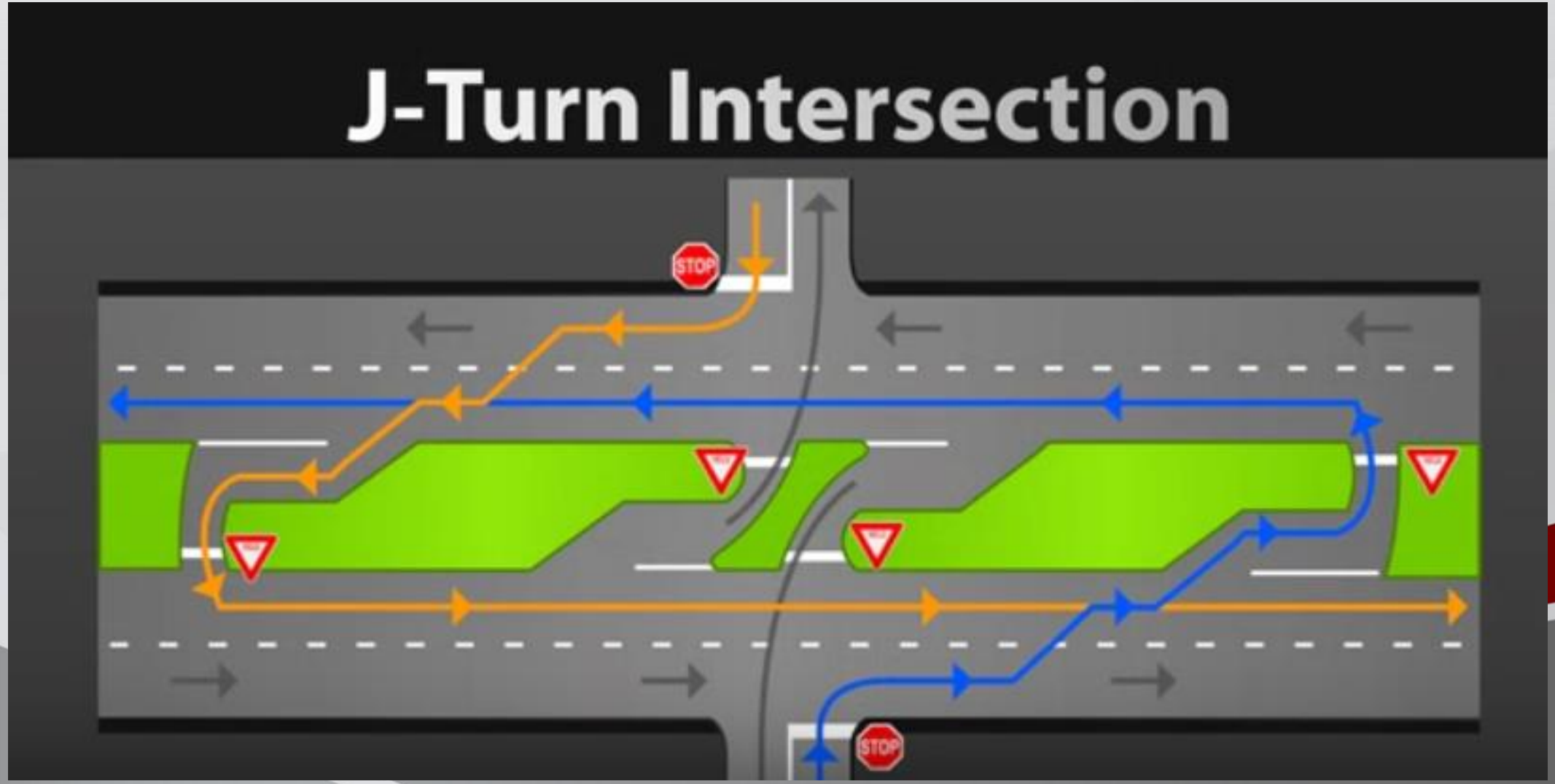

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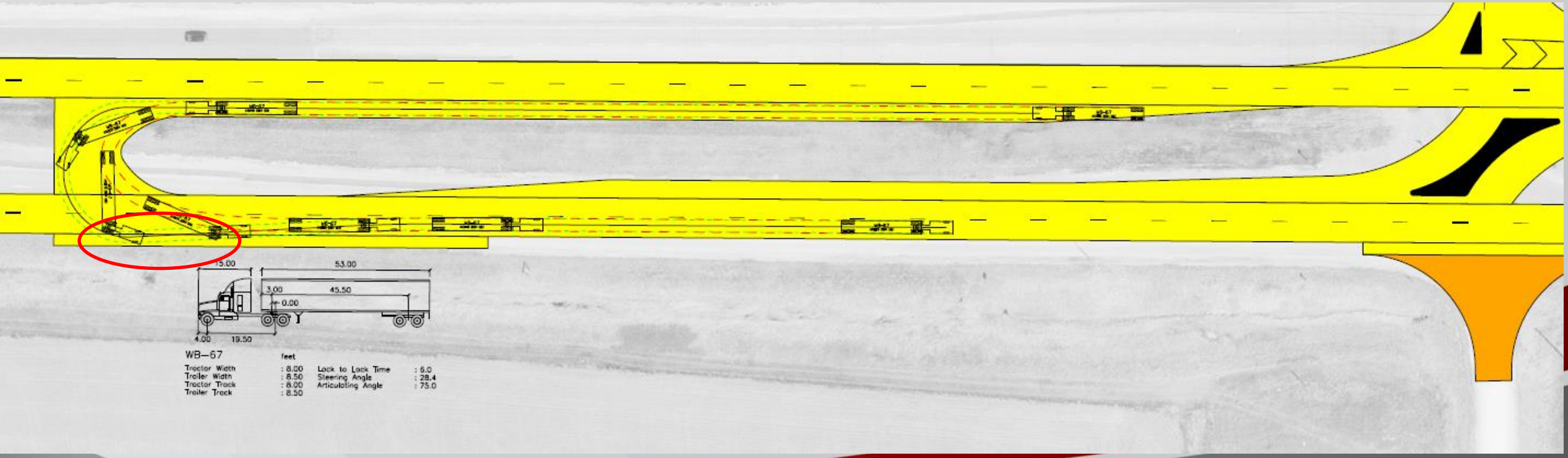
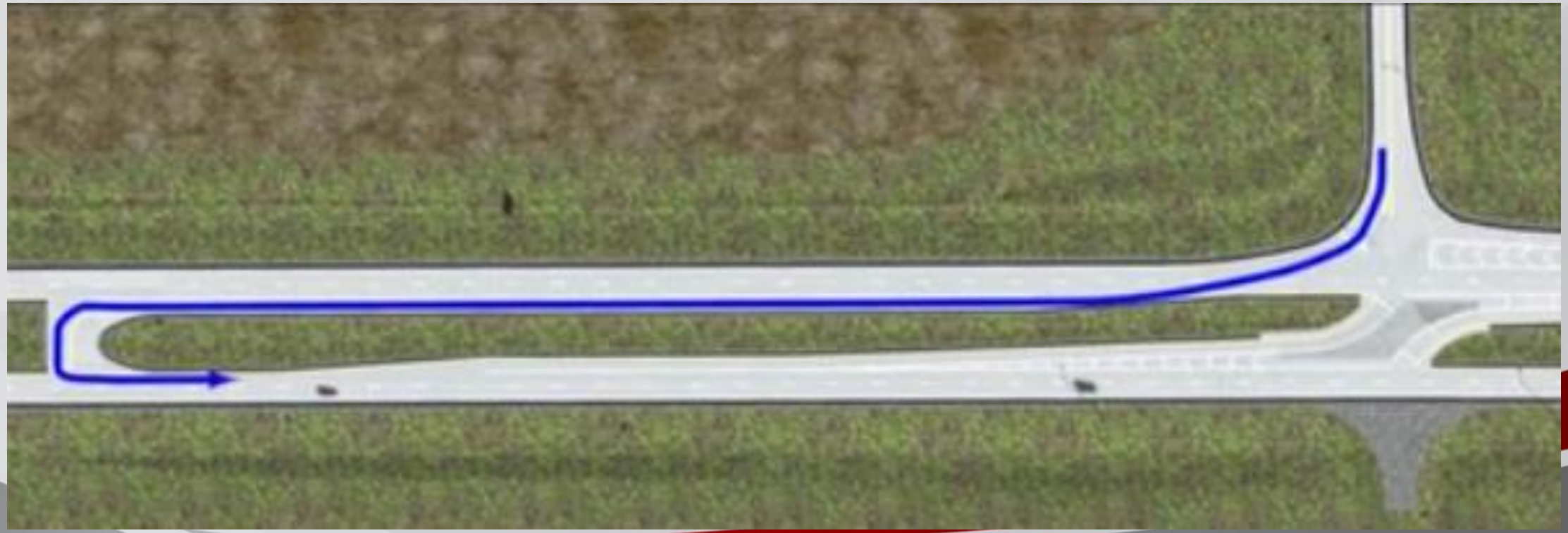


Special Intersection Designs (J-Turns)

- https://www.youtube.com/watch?time_continue=12&v=rZV6nuHDV4U



Painted Stop Sign Islands

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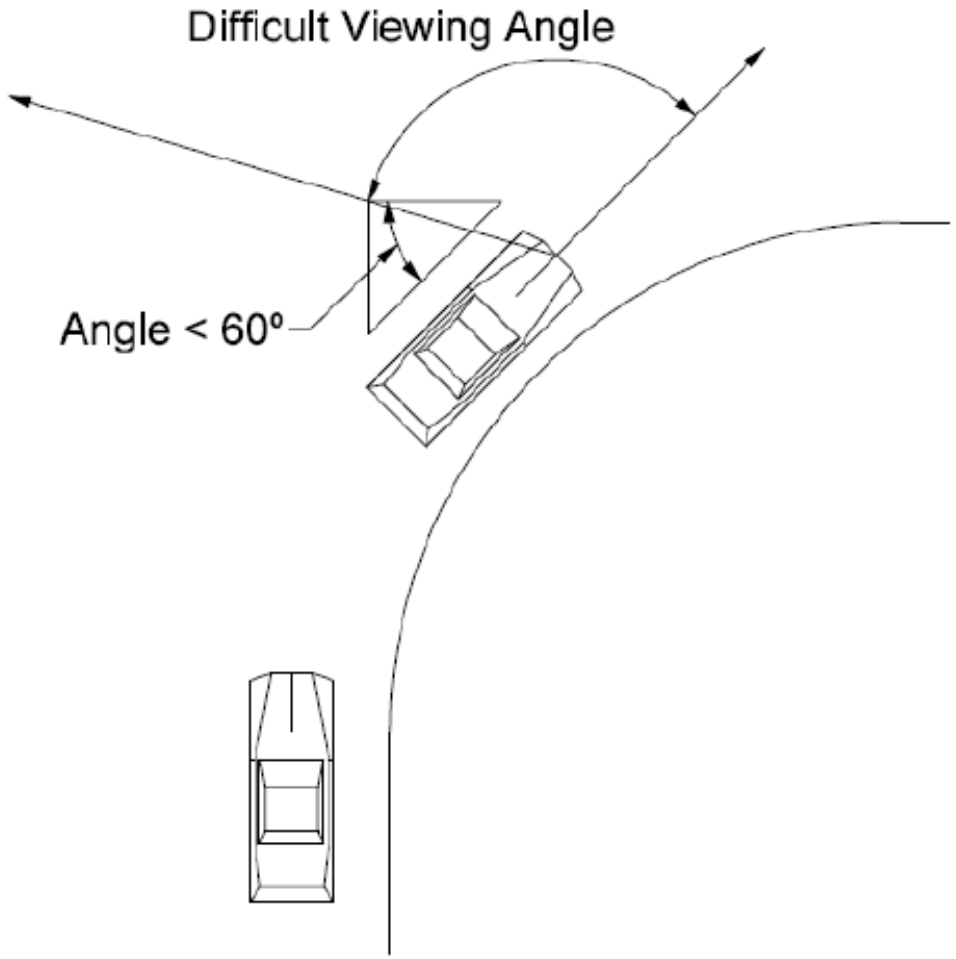

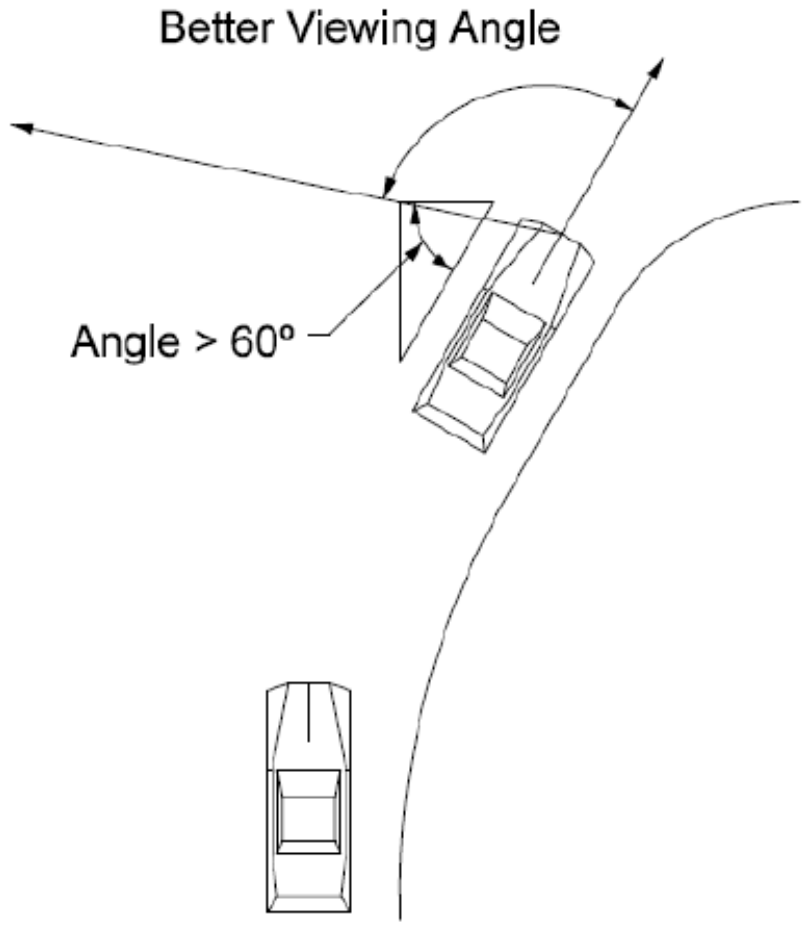

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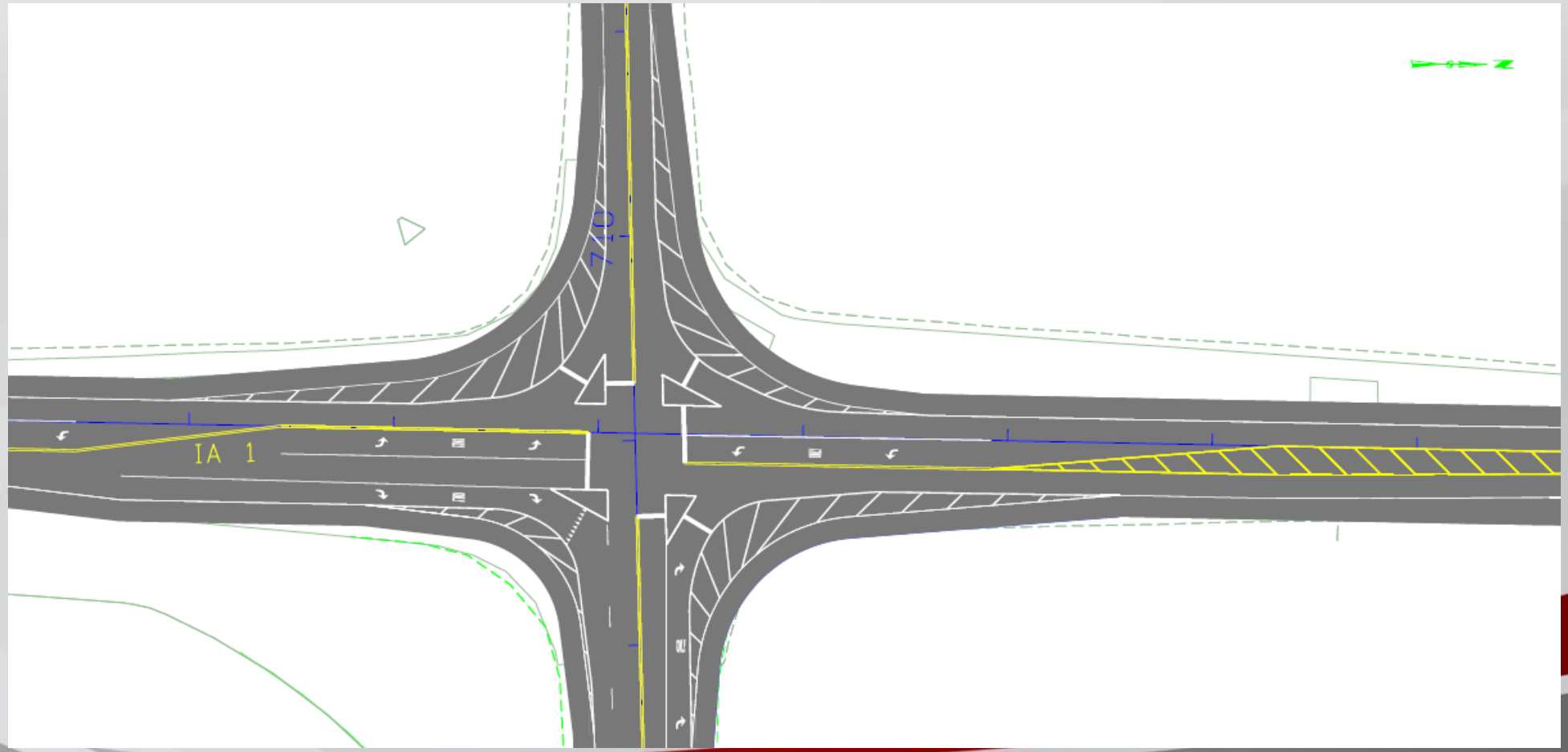
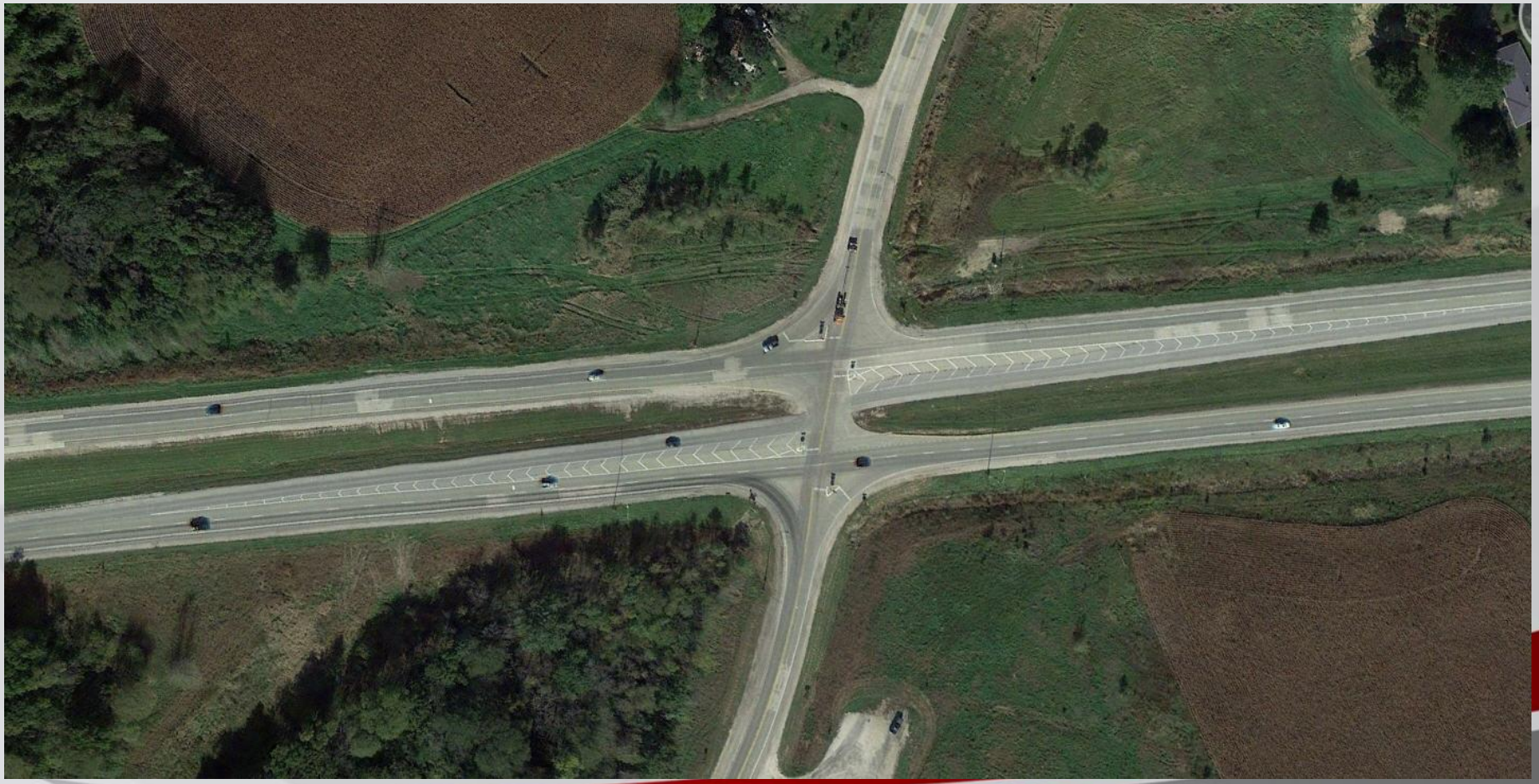


Offset Left turns

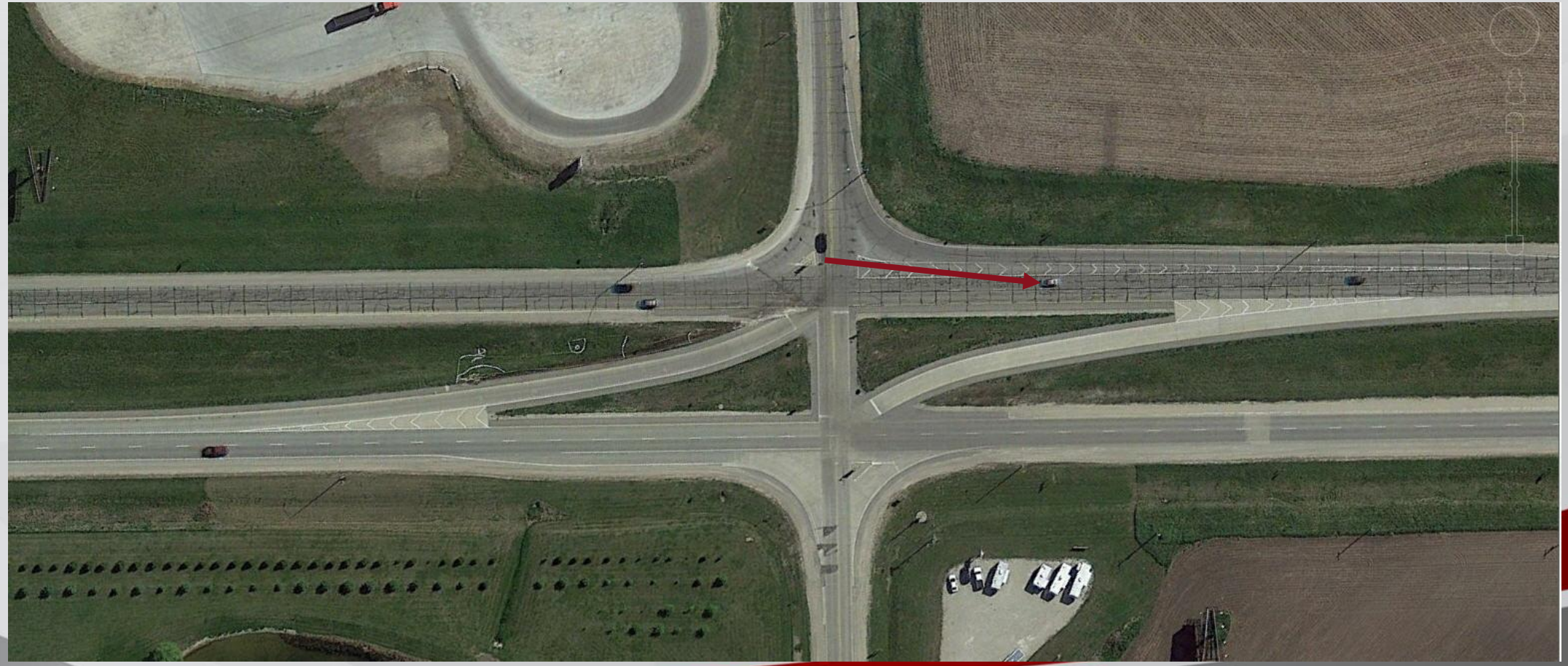


Offset Left and Right turns

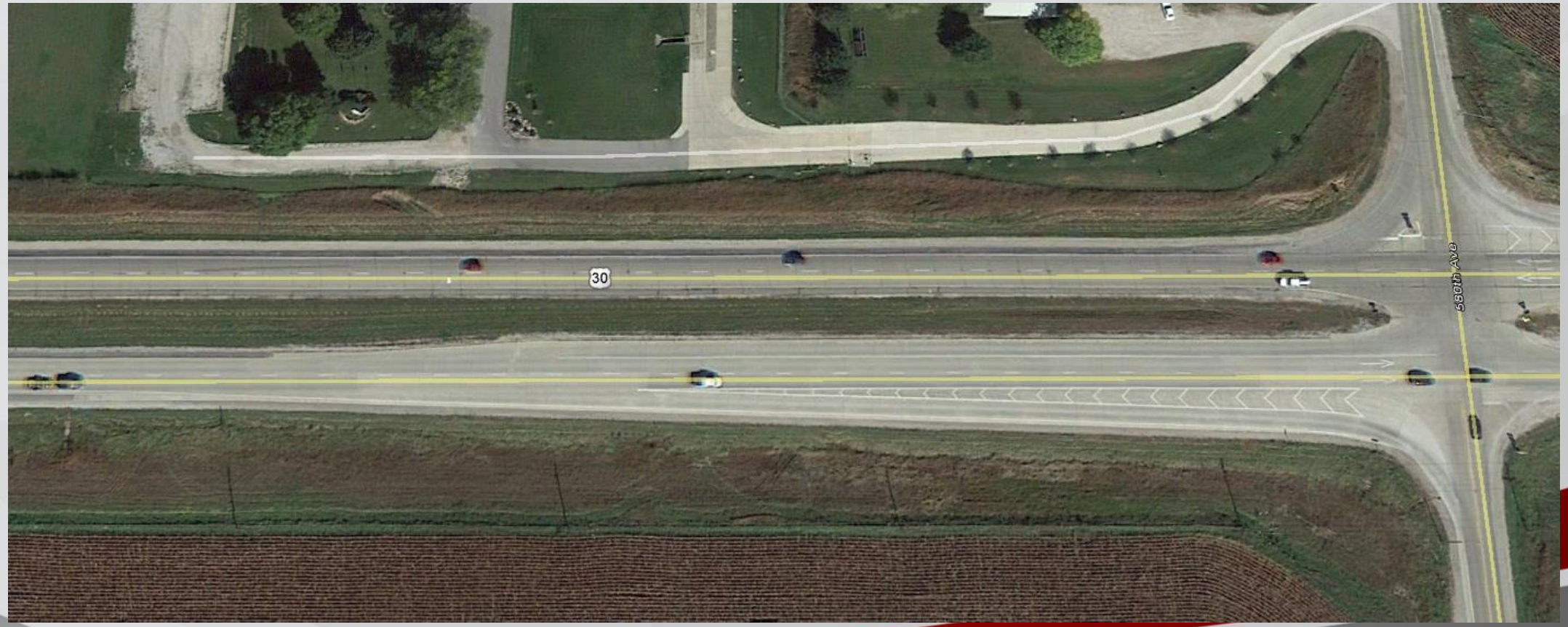
- Advantages of offset left turn lanes
  - The offset allows left turns an unobstructed view of oncoming traffic. Standard left turn lanes have the opposing left turner blocking your view potentially hiding an oncoming vehicle
- Advantages of offset right turn lanes
  - This configuration moves the right turners out of the sight triangle of a stopped vehicle at the side road. A standard turn lane allows a vehicle on the through roadway to be hidden by a turning vehicle.

Offset Left and Right turns(Offset Left)

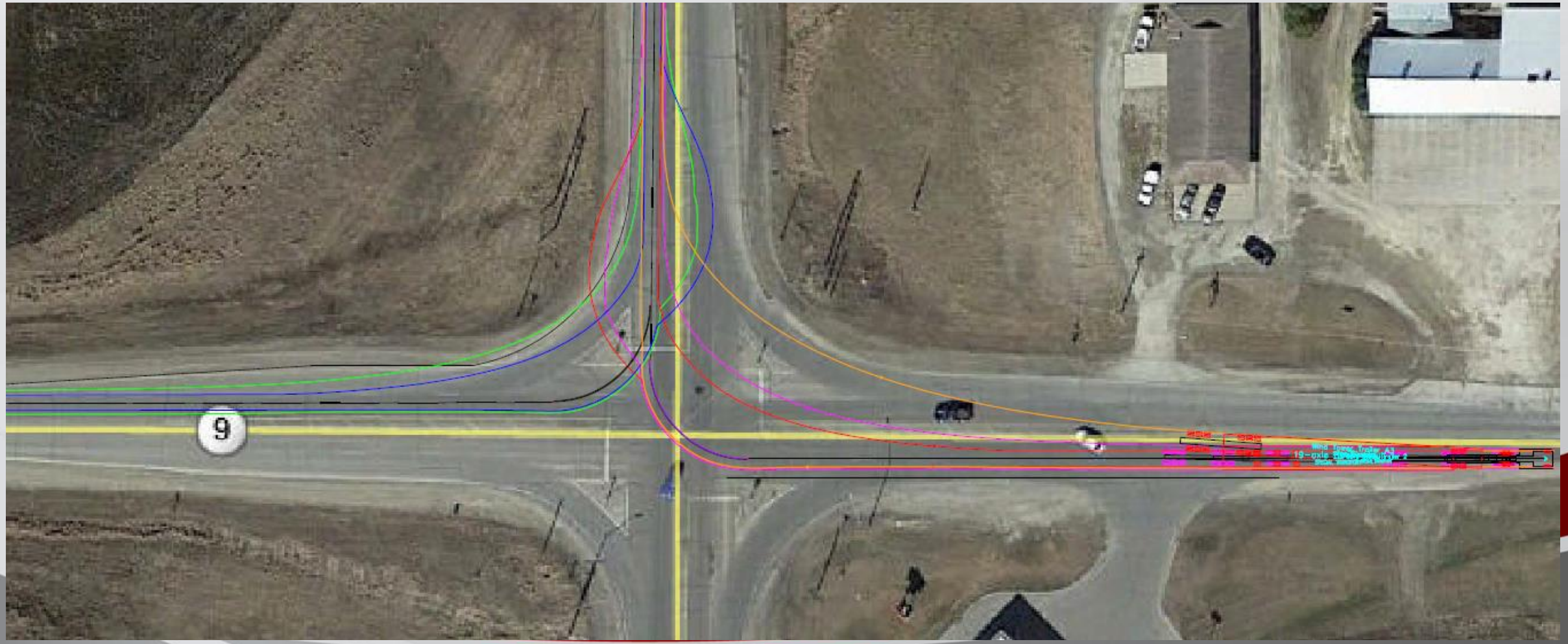
Offset Left and Right turns



Offset Left and Right turns



Auto Turn Program



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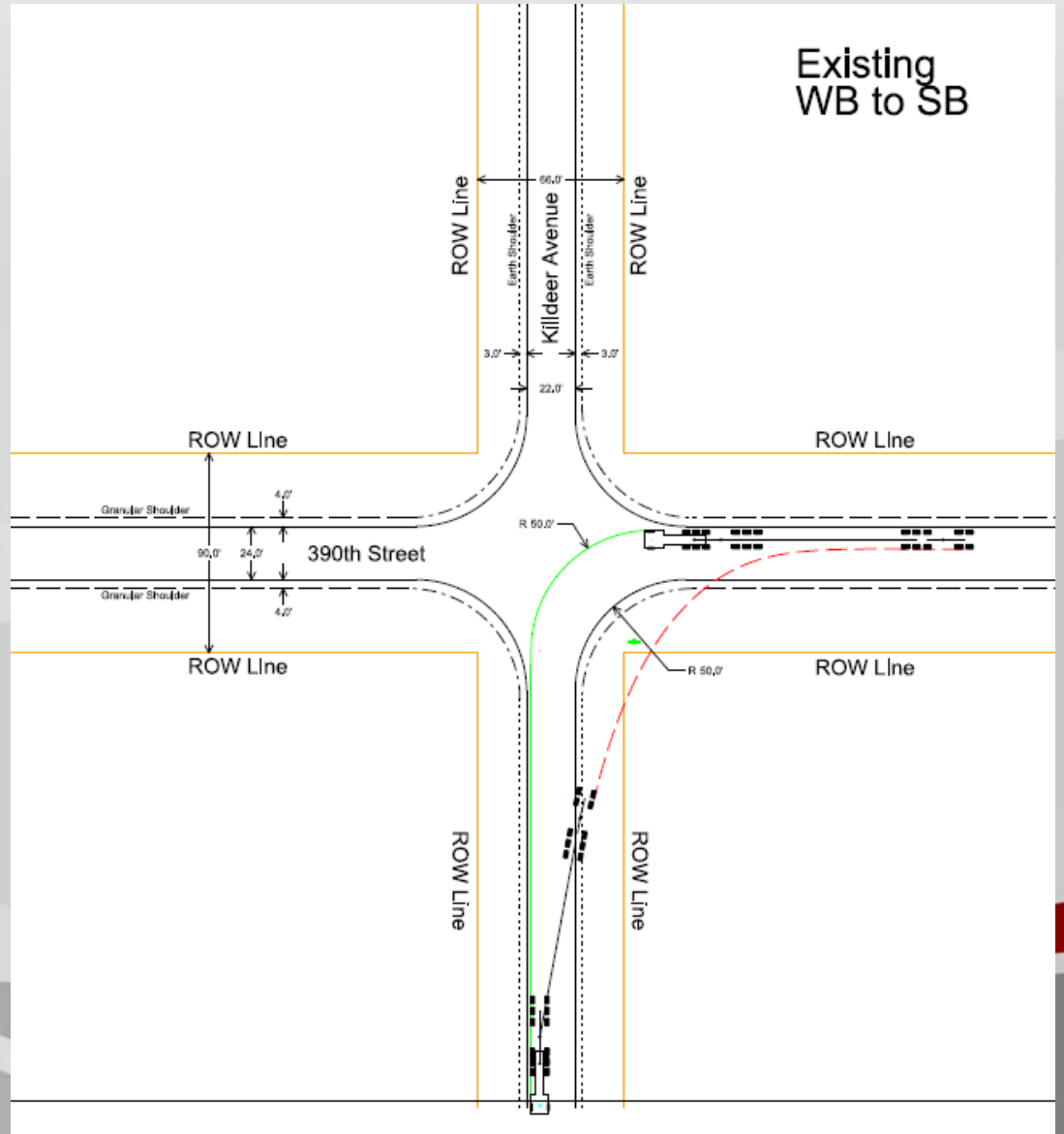

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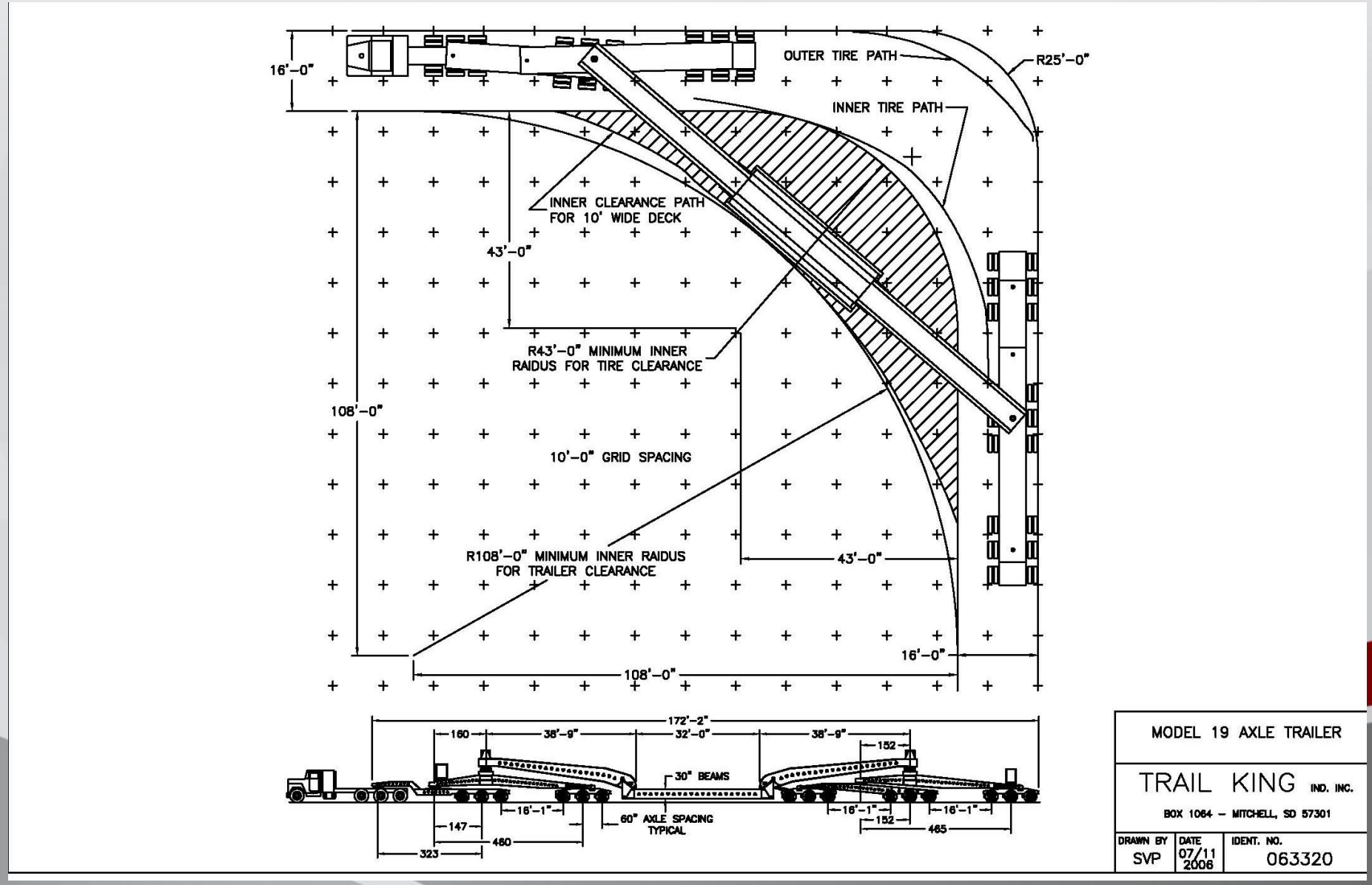

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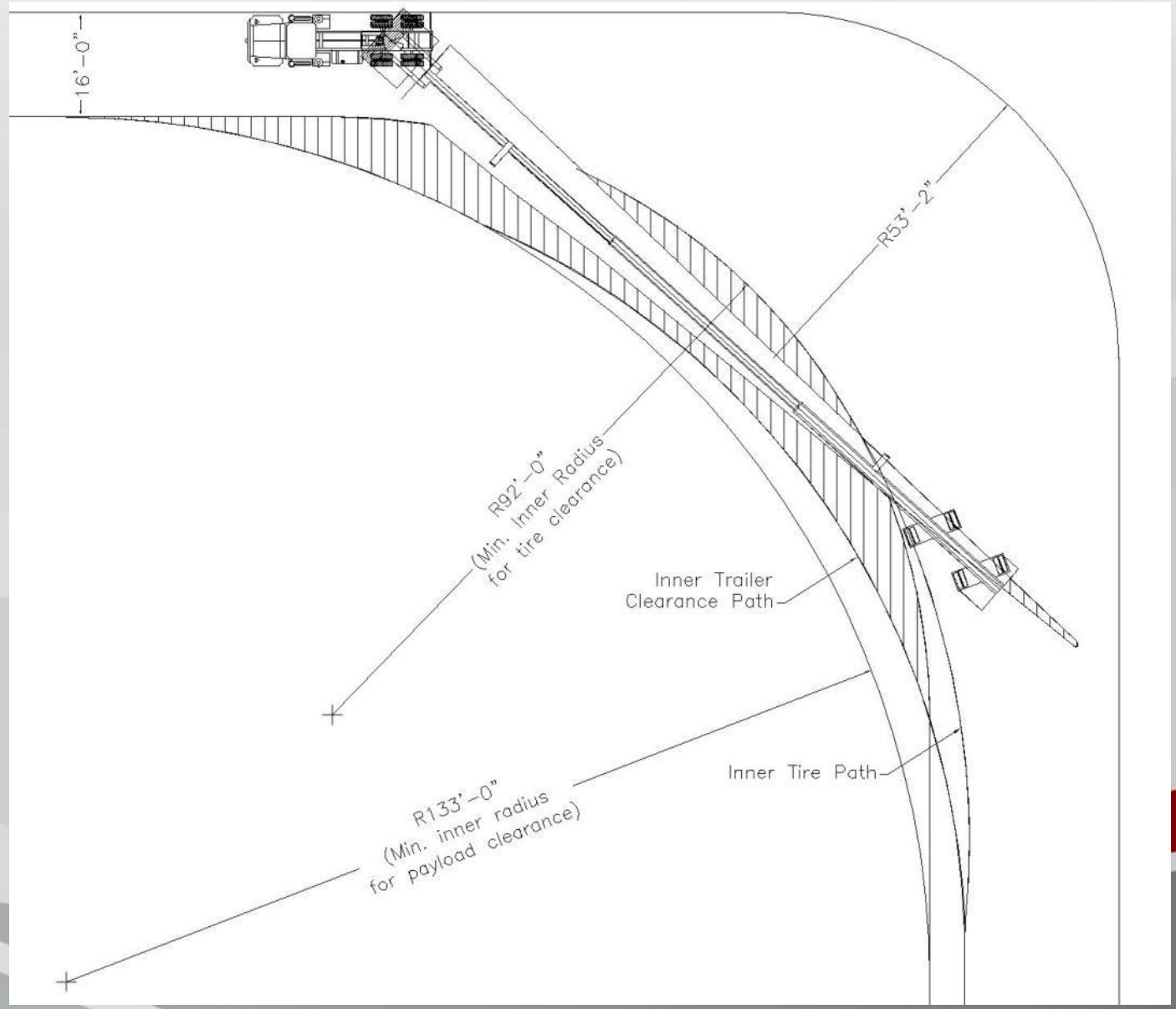

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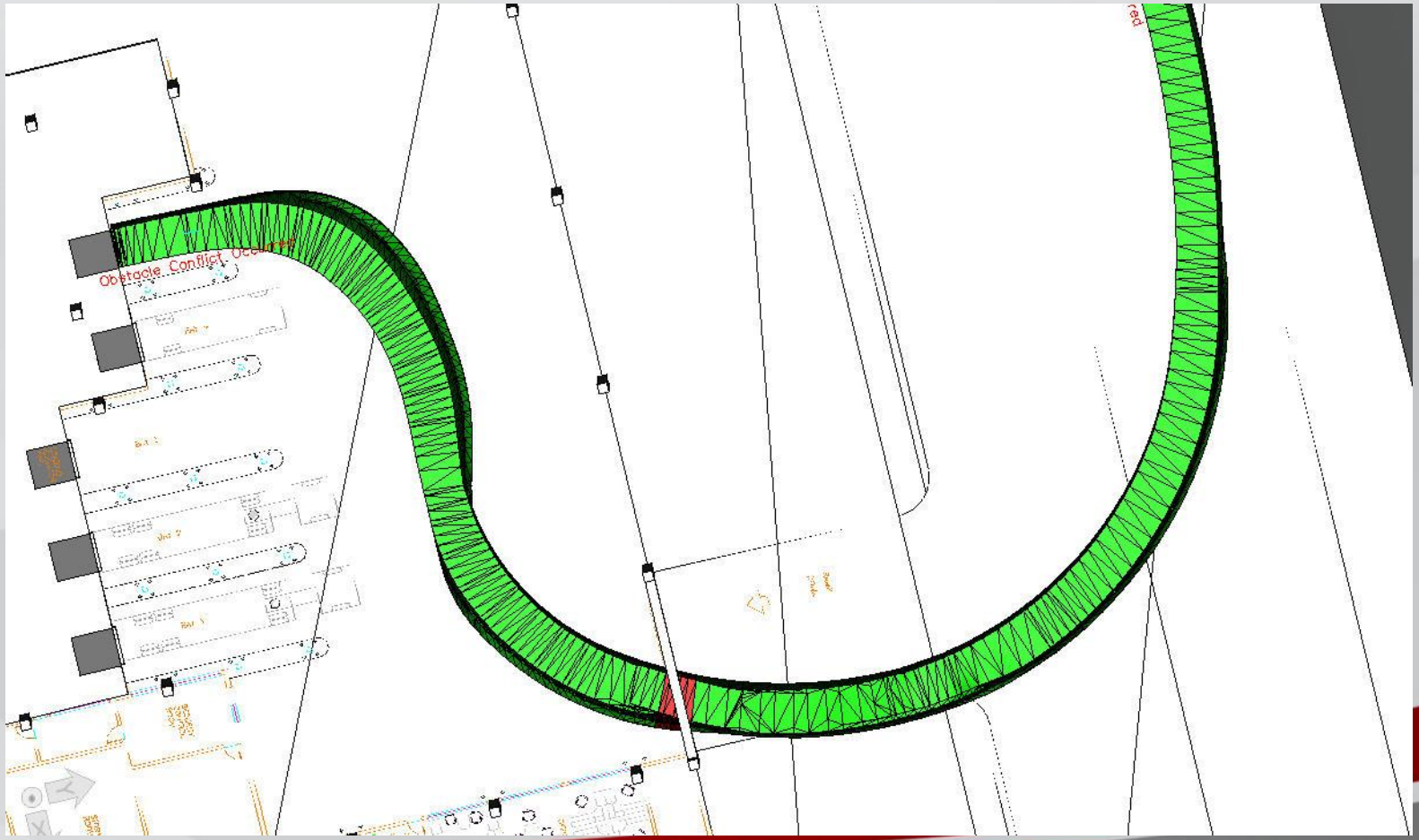

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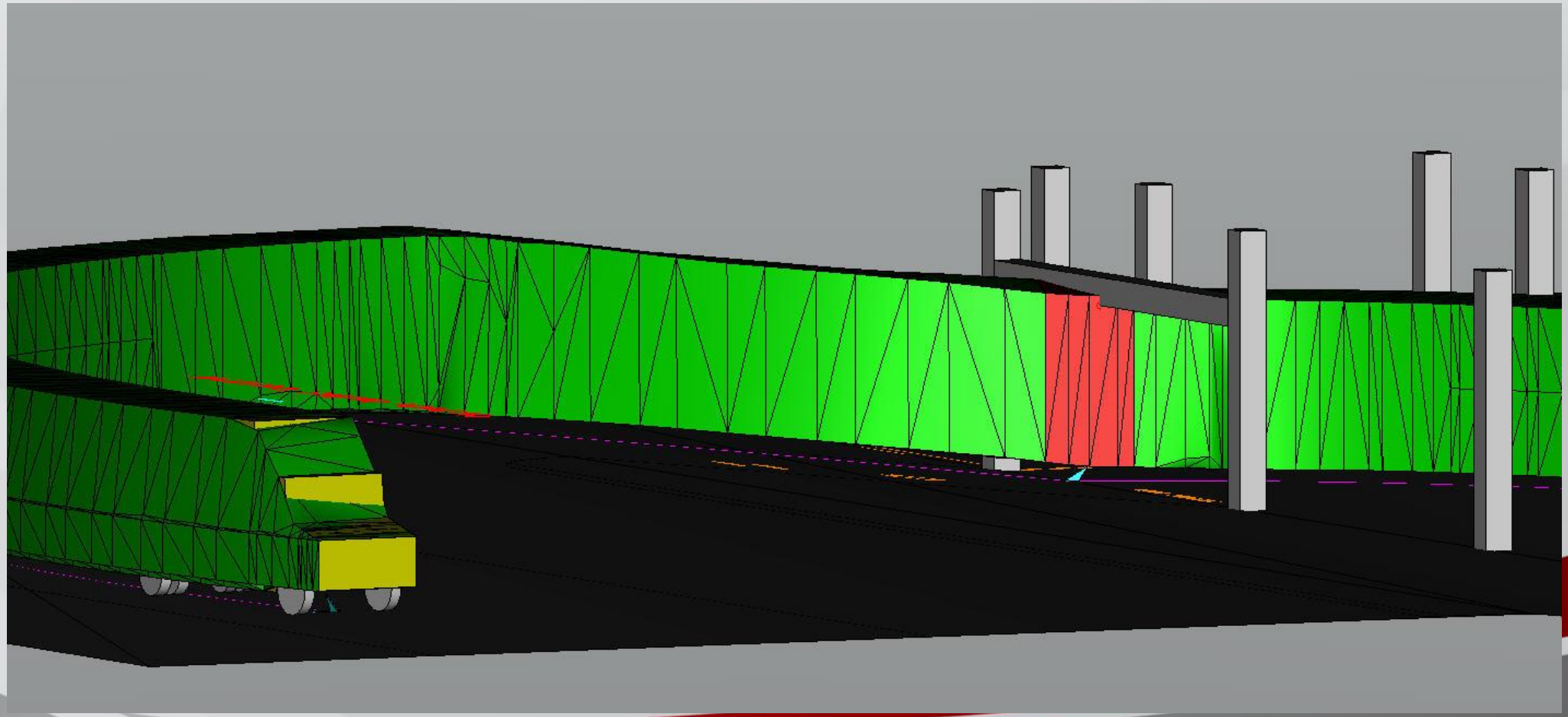
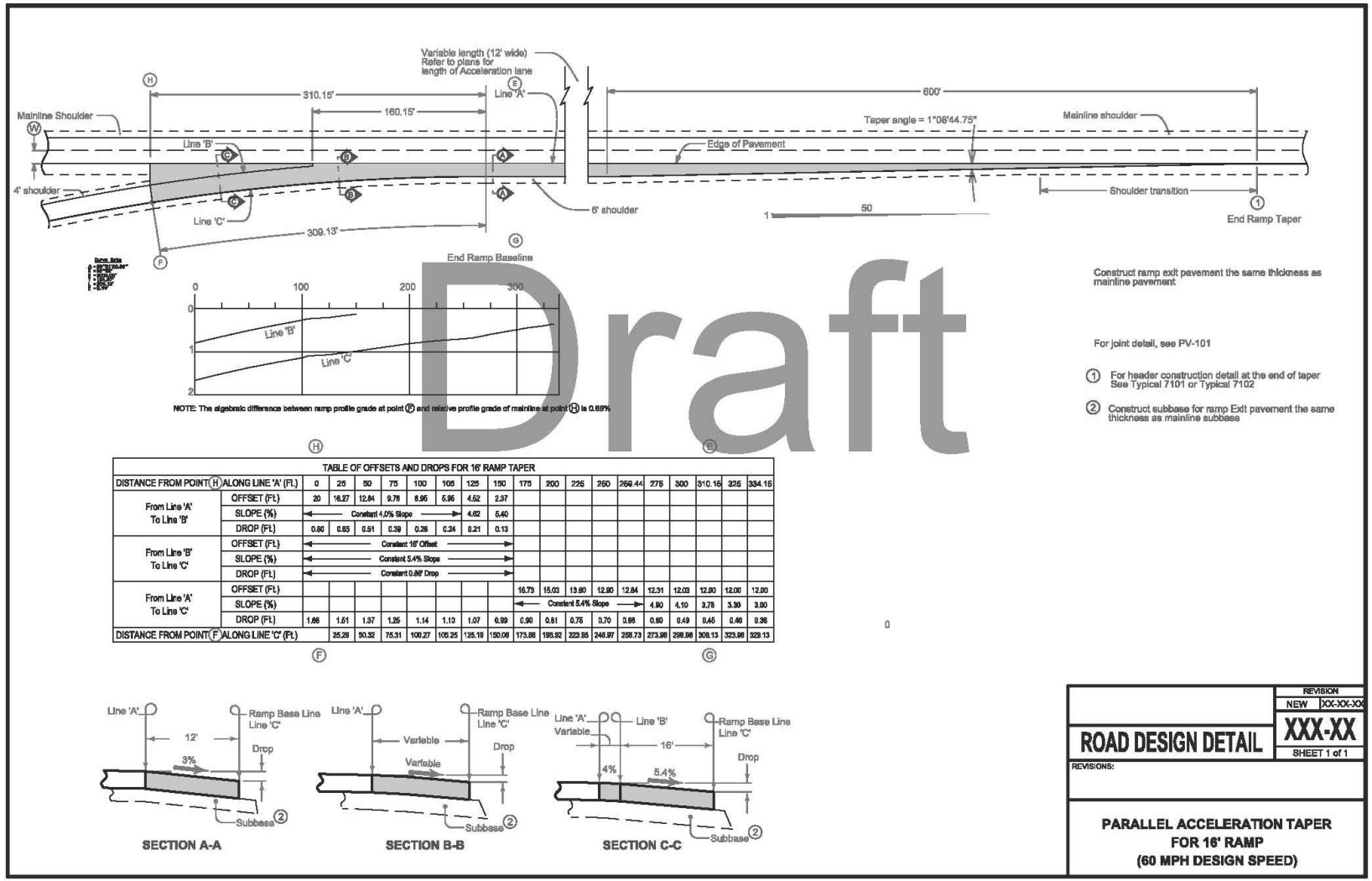


Interchange parallel acceleration/deceleration lanes on ramp tapers

- Allows more time for trucks to accelerate prior to merging with traffic or to decelerate before the first curve of the exit ramp without disrupting the flow of traffic on the through roadway
- Allows for better gap acceptance for the merge/diverge maneuver in heavier traffic

Interchange parallel acceleration/deceleration lanes on ramp tapers



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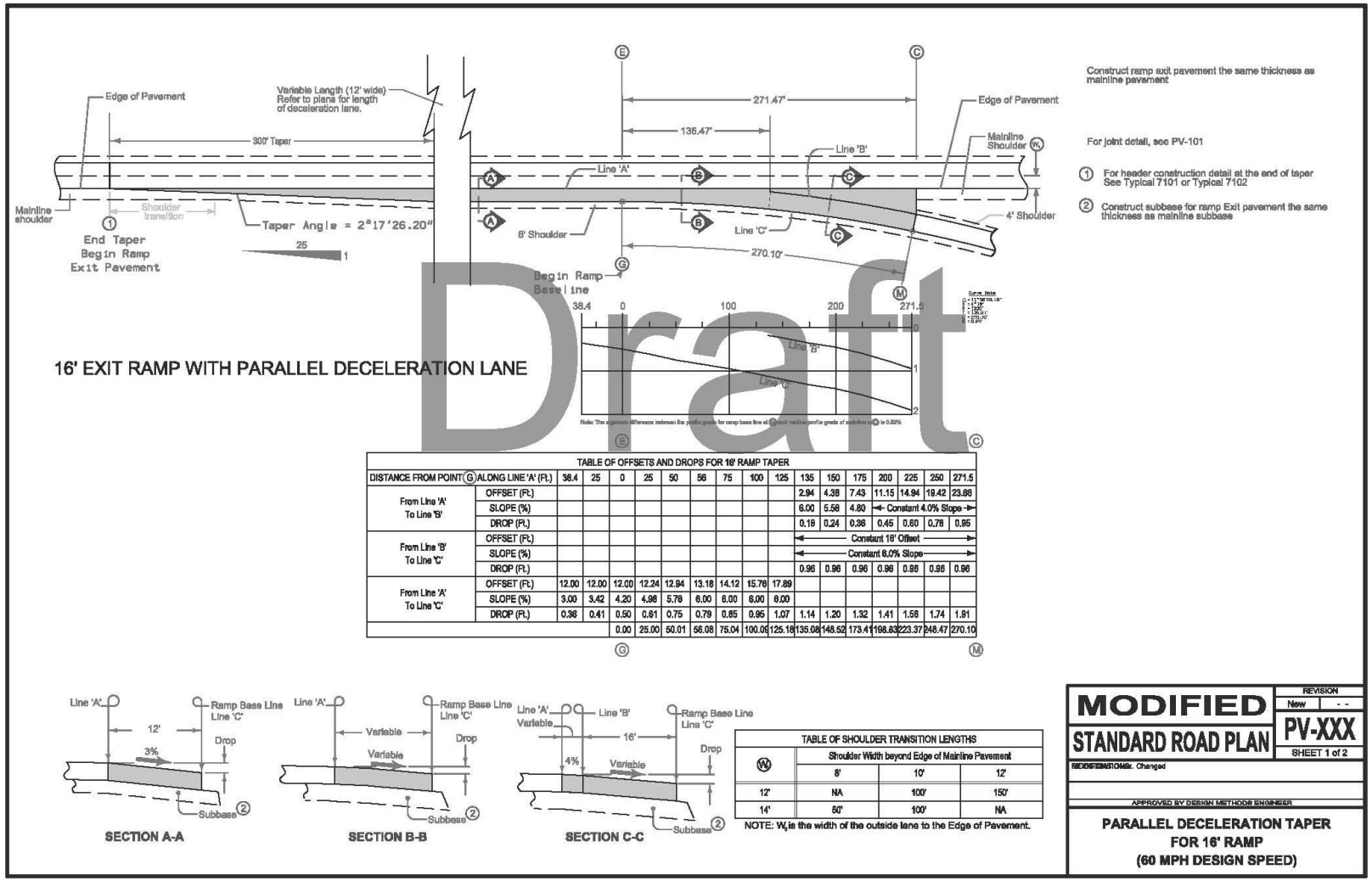


TABLE OF OFFSETS AND DROPS FOR 16' RAMP TAPER

DISTANCE FROM POINT (G) ALONG LINE 'A' (Ft.)		38.4	25	0	25	50	56	75	100	125	135	150	175	200	225	250	271.5
From Line 'A' To Line 'B'	OFFSET (Ft.)										2.94	4.38	7.43	11.15	14.94	19.42	23.66
	SLOPE (%)										6.00	5.56	4.80	← Constant 4.0% Slope →			
	DROP (Ft.)										0.18	0.24	0.36	0.45	0.60	0.78	0.95
From Line 'B' To Line 'C'	OFFSET (Ft.)										← Constant 16' Offset →						
	SLOPE (%)										← Constant 6.0% Slope →						
	DROP (Ft.)										0.96	0.96	0.96	0.96	0.96	0.96	0.96
From Line 'A' To Line 'C'	OFFSET (Ft.)	12.00	12.00	12.00	12.24	12.94	13.18	14.12	15.76	17.89							
	SLOPE (%)	3.00	3.42	4.20	4.98	5.76	6.00	6.00	6.00	6.00							
	DROP (Ft.)	0.36	0.41	0.50	0.61	0.75	0.79	0.85	0.95	1.07	1.14	1.20	1.32	1.41	1.56	1.74	1.91
				0.00	25.00	50.01	56.08	75.04	100.06	125.18	135.08	148.52	173.41	198.83	223.37	248.47	270.10

(G) (M)

TABLE OF SHOULDER TRANSITION LENGTHS

(W)	Shoulder Width beyond Edge of Mainline Pavement		
	8'	10'	12'
12'	NA	100'	150'
14'	50'	100'	NA

NOTE: W_n is the width of the outside lane to the Edge of Pavement.

MODIFIED STANDARD ROAD PLAN

REVISION: New - -

PV-XXX

SHEET 1 of 2

REDESIGNATIONS: Changed

APPROVED BY DESIGN METHODS ENGINEER

PARALLEL DECELERATION TAPER FOR 16' RAMP (60 MPH DESIGN SPEED)

Special Interchange Designs (Diverging Diamond)

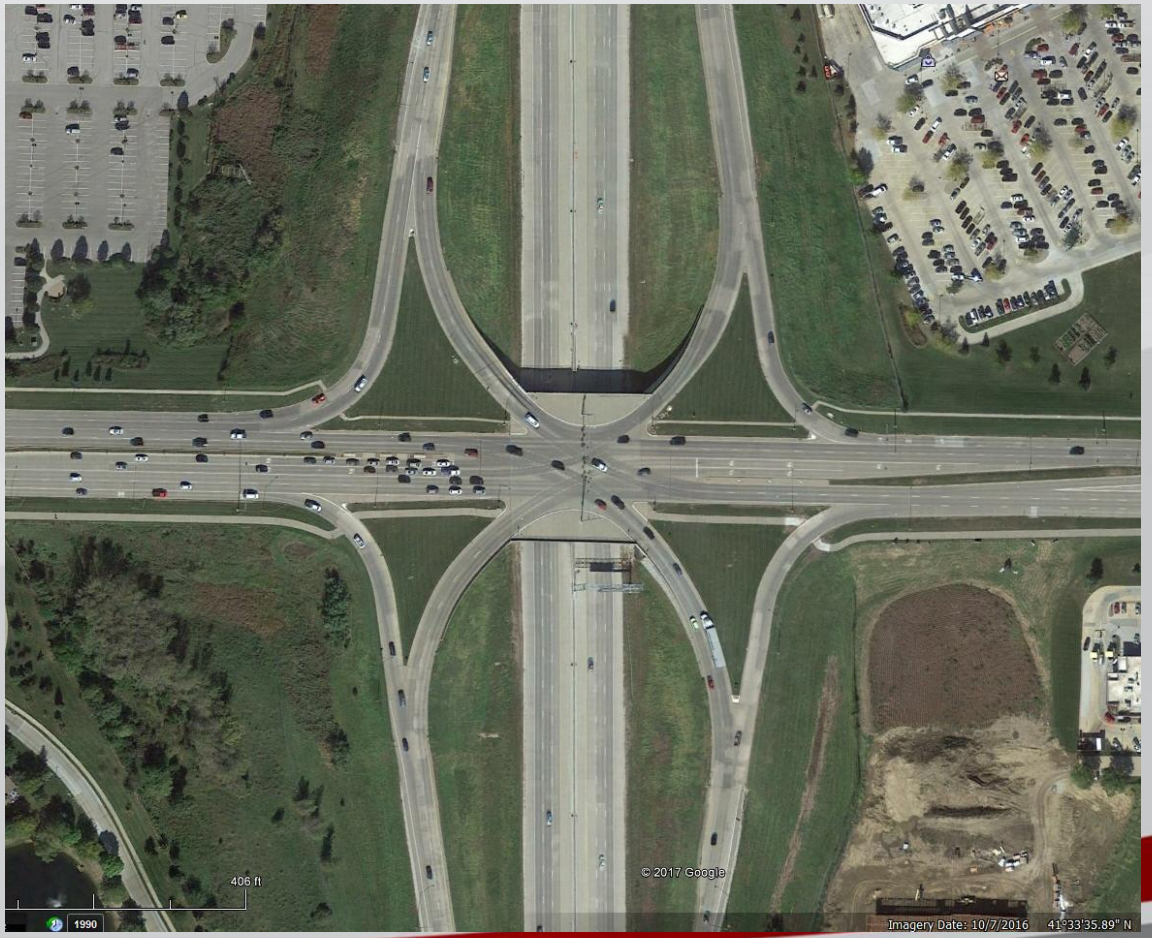
Special Interchange Designs (Diverging Diamond)

- Advantages of a Diverging Diamond
  - Left turn movements are unopposed
  - The configuration results in greater ramp storage
  - Signal timing is greatly simplified and cycles of the signals are shorter

Special Interchange Designs (Diverging Diamond)

- https://www.bing.com/videos/search?q=diverging+diamond+benifits&&view=detail&mid=F832F8DF6C71FC46C17AF832F8DF6C71FC46C17A&FORM=VRDGAR

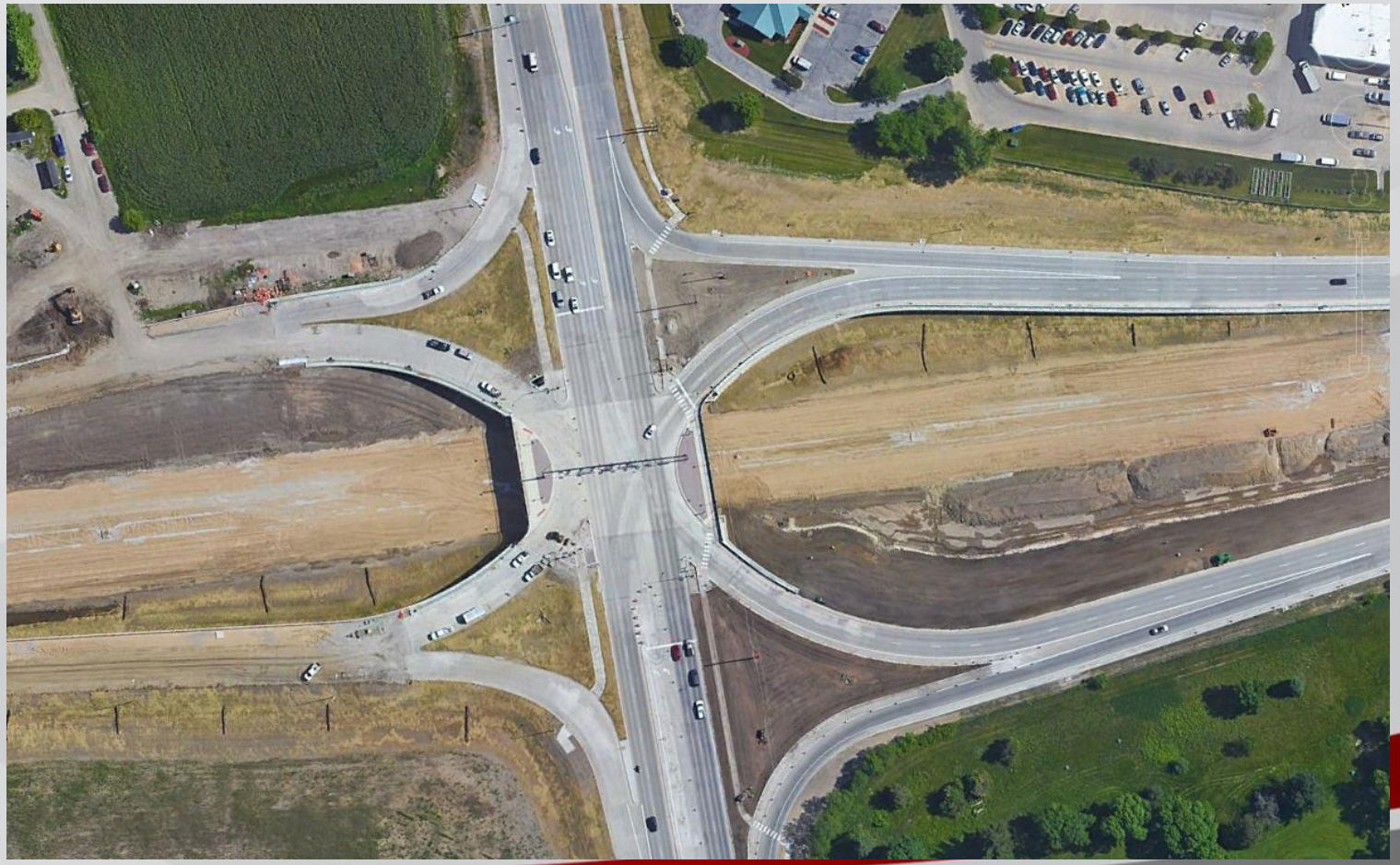
Special Interchange Designs (Single Point Interchanges)



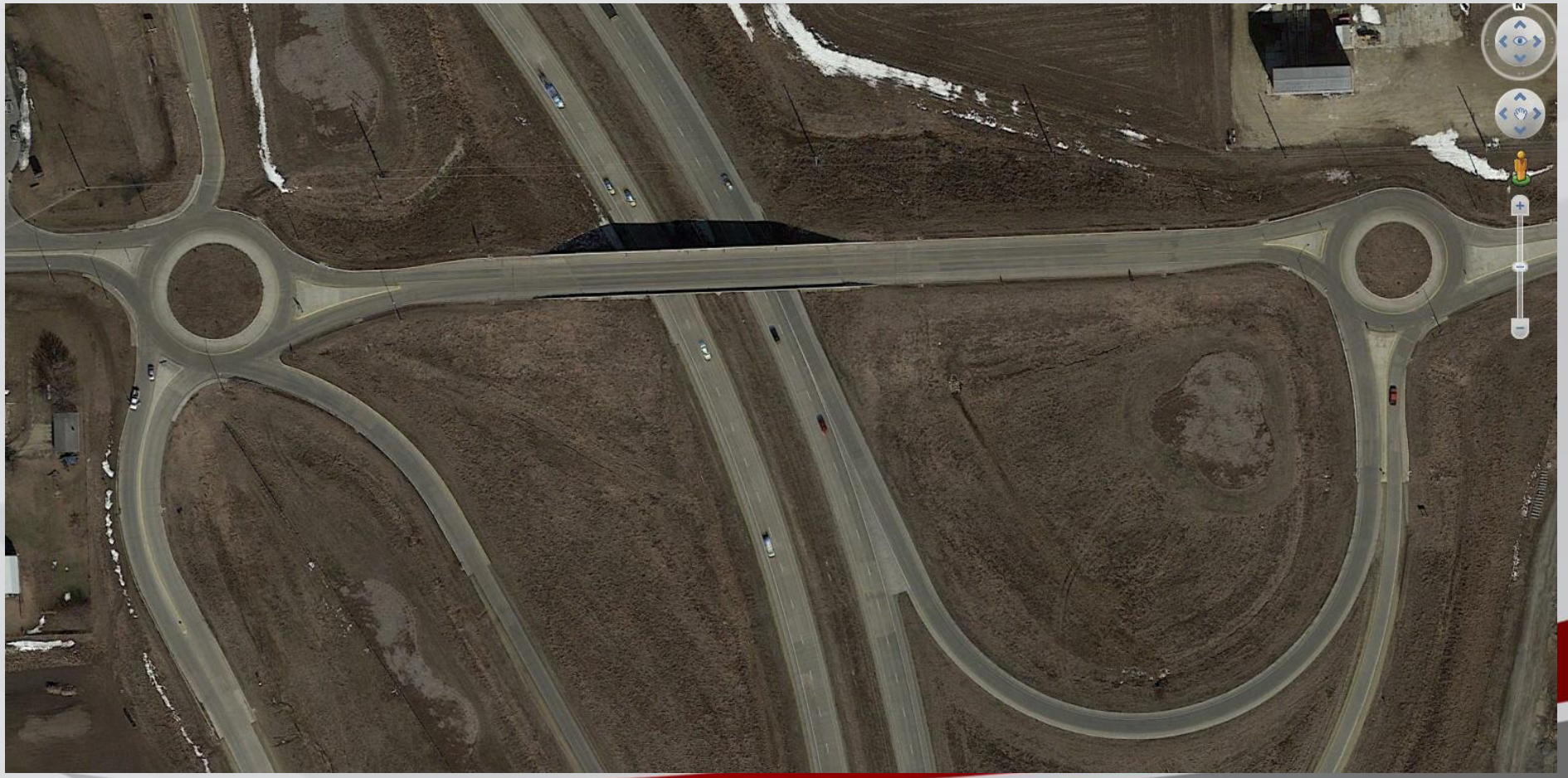
Special Interchange Designs (Single Point Interchanges)

- Advantages of Single Point Interchange
  - Both left turn movements are allowed to happen simultaneously which greatly improves the efficiency of the interchange
  - Large radii for the turning movements make it easier for large vehicles to maneuver through the interchange

Special Interchange Designs (Single Point Interchanges)



Special Interchange Designs
(Diamond Interchange with roundabout terminals)



Special Interchange Designs (Diamond Interchange with roundabout terminals)

- The benefits and disadvantages are the same as a roundabout at an intersection
- The yield condition at the ramp roundabouts helps minimize queuing on the ramps of the interchange

Traffic management considerations during design

- Traffic Management Office
- Traffic Management Plans for Projects
  - **Transportation Management Plan (TMP)** – The overarching purpose of the TMP is to document the design approach and other decisions regarding management of traffic during construction. The TMP contain various additional Plans such as Traffic Incident Management Plan, Crisis and Communication Plan, Public Outreach Plan.
  - **Engagement and Communication Plan**
  - **Emergency Alternate Route Guide**
  - **Queue Detection and Congestion Warning**
  - **Additional Highway Helper**
  - **1/10 Mile Marker Signing**
  - **Incident/Crisis Communications Plan**